CHAPTER III

GENERAL FACILITIES CONSIDERATIONS

A. GENERAL DESIGN GUIDELINES

Design guidelines and standards are presented below for the general considerations of a PWSS. Design criteria for the specific components of the PWSS (i.e., source development, treatment, storage, pumping, distribution, and chemical storage, handling and application) are included in the remaining chapters.

1. ALTERNATIVE SOLUTIONS AND REGIONALIZATION - Feasible alternatives should be considered for a PWSS design, e.g., KSA 19-3545 to 19-3556 provide for cooperative water supplies via the Public Wholesale Water Supply District Act. This act allows water supply entities to take advantage of the benefits associated with regionalization of water systems. It requires significant prior planning before these benefits can be realized. Also, interconnections between systems are encouraged.

2. SERVICE NEEDS - An appraisal of future requirements for service must include all potential users including residential, commercial, institutional, and industrial. Historical water use and population data should be used to project minimum, average, and maximum daily needs. KWO compiles water use data for many Kansas municipalities which could be used to estimate needs for similar cities (9). The possibility of fire flows or other heavy demands should also be considered along with water losses. Water savings from implemented water conservation programs should be recognized. The water source(s) and treatment facilities shall be designed for the maximum day demand at the design year.

3. DESIGN PERIODS - The planned installation of any PWSS component requires an estimate of its needed capacity and the expected life of its major materials of construction. A 20 to 30 year design period is typical of most installations (e.g., intake structures, pump stations, and treatment works) but 50 year design is not uncommon for major impoundments or long raw water transmission lines. Shorter design periods of 10 to 20 years are appropriate for scattered wells or any other less costly structures.

   Phased construction of "as needed" facilities is permitted but supporting facilities not built economically and conveniently in stages should be constructed with capacities for future use. Examples of "as needed" facilities include pumps, tanks, and treatment processes.

4. CONSERVATION - The design should conserve water, chemicals and power. Every significant energy demanding activity should be evaluated and considered in comparing design alternatives. Emphasis should be placed on water conservation. This includes the recycling of water in the treatment scheme, reduction of leakage and unnecessary use in the distribution system, and the utilization of water saving devices and methods. KWO has published guidelines and reviewed measures for water conservation (10,11). DWR and KWO require conservation programs for PWSSs requesting new appropriations or purchasing water from federal reservoirs. DWR may require existing PWSSs to initiate a conservation program if their water use is determined to be excessive.

5. NEW PROCESSES, METHODS, CHEMICALS, AND EQUIPMENT - Innovative designs will be approved if they can be demonstrated to be effective over the range of water quality, flow, time, weather, and climate anticipated for the new system. Also, operator skills and equipment support for the innovative design must be demonstrated. The design engineer must submit to KDHE a detailed plan of testing for the proposed innovation, and after its approval, must document the test conclusions showing why an exception should be granted to the minimum design standards. Furthermore, the following conditions must be met:

   a. The PWSS should obtain from the equipment supplier/contractor appropriate performance guarantees for the innovative equipment, process, or design. Copies of performance guarantees provided by the equipment supplier/contractor to the PWSS should be submitted to KDHE.

   b. The PWSS, by official document action, must certify they are aware of the potential risks of the "non-standard" equipment, process, or design and that the PWSS has the funds to refinance and construct a conventional process to replace the failed system and that adequate treatment will be provided until the failed system is replaced.

   c. Conditional approval of a "non-standard" equipment, process, or design at any site does not guarantee subsequent approval of similar units. Each proposed application will be considered on a case by case basis and shall be discussed with the Water Supply Section Chief of the Bureau of Water prior to approval.

6. WASTE HANDLING AND DISPOSAL - Important considerations in evaluating alternative treatment processes are the quantities and characteristics of residues generated by the processes. The quantities and characteristics of such residues depend on the water source as well as the treatment chemicals and processes utilized. Some processes may not be viable because of the cost or regulatory restrictions on the handling and disposal of the residues/wastes. In the design of water works, provisions must be made for proper disposal of all water treatment plant residues/wastes in accordance with KDHE regulations.

7. COSTS AND FINANCING - Cost estimates shall be made for all alternative designs and shall include their capital and O&M costs. Sources and methods of financing the recommended design shall be identified. EPA has published a resource guide for financial assistance programs for small water supply systems (12).

B. PLANT SITING CONSIDERATIONS

1. EVALUATION OF SITE ALTERNATIVES - In general, the selection of the plant site should include a comparison of the following features for each site alternative and for present and future needs:

   a. Water quality of the source.

   b. Availability of land; its cost and taxes.

   c. Site preparation requirements for cleaning, grading, and landscaping.

   d. Identification of easements and acquisition of right-of-ways.

   e. Site drainage, flood protection, and impact.

   f. Soil, foundations, and groundwater conditions.

   g. Adaptability to plant layout needs.

   h. Adjacent and surrounding developments.

   i. Public attitude toward proposed facilities.

j. Availability of needed utility services. Two independent power sources are preferred to minimize standby needs. However, auxiliary on-site generation is an acceptable substitute for key equipment and facilities.

k. Convenience to roads, highways, and railroads.

l. Emergency, civil defense, and natural hazards.

m. Environmental control restrictions.

2. PLANT SITING RESTRICTIONS - KAR 28-15-17 states that a new or expanded facility shall not be initiated or constructed at a site which the department determines:

a. Is subject to a significant risk from earthquakes, floods, fires, or other disasters which could cause a breakdown of the PWSS or a portion of it;

b. Except for intake structures, is within the floodplain of a 100 year flood, or is lower than the recorded high water level where appropriate records exist; or

c. Is adjacent to a major source of pollution, which KDHE determines has a potentially adverse influence on the water supply.

3. PWSS AND POLLUTION SOURCES - The capabilities of the existing and proposed water works must be evaluated considering possible effects by adjacent pollution sources. Such effects could include actual or potential impairment of PWSS water quality.

4. SANITARY SURVEY - A sanitary survey should be conducted for each new water works facility. A sanitary survey is an organized effort to collect and assimilate pollution information for a given area. It includes an evaluation of watershed, stream, and storage characteristics in terms of their natural and developed states. Of paramount importance are the water quality variations with time and distance. Existing and future pollution control facilities should be evaluated. Risk analysis should be made to evaluate pollution problems caused by transportation failure, ruptured oil tanks, or other potential sources.

C. PLANT LAYOUT AND OTHER CONSIDERATIONS

1. PLANT AND BUILDING LAYOUT - Design of a PWSS site and facilities involves structural, functional, aesthetic, and cost considerations for the proposed and future additions. Applicable state and local building, electrical, fire, and plumbing codes more stringent than KDHE requirements must be met. Also, applicable ASTM, AWWA, and NSF standards must be satisfied. Design considerations include:

   a. Centralized operation with accessibility to facilities.

   b. Available utility service connections; adequate ventilation, lighting, heating, sewers, and drainage.

   c. Elimination of operating inconveniences and hazardous conditions.

   d. Enclosure, separation, and distribution of facilities.

   e. Space for offices, meeting rooms, lunch room, laboratory, O&M areas, processes, and storage. Process areas should also include room for equipment disassembly for maintenance purposes.

   f. Provision of access ways for water and waste streams, utilities, chemicals, drainage, flooding, and O&M personnel, visitors, equipment, and vehicles.

   g. Architecture, landscaping, buffer zones and neighbors.

2. MATERIALS OF CONSTRUCTION - The potential effect of weathering, corrosion, and scale formation should be evaluated for all components of a PWSS. Also, the impact of corrosion products and control methods on water quality shall be considered. Contact between dissimilar metals should be avoided to minimize galvanic action.

3. VENTILATION AND DEHUMIDIFICATION - Designs shall consider the buildup of chemicals and/or moisture due to leakage and poor air circulation in confined spaces. These potential areas (such as pump stations, filter pipe galleries, chemical feed areas, and basements) should be properly cleaned, ventilated and/or dehumidified to prevent accidents and corrosion.

4. OPERATION AND MAINTENANCE - Considerations shall be given to the O&M requirements of proposed facilities in terms of anticipated manpower and equipment needs. Manpower needs include certified operators and maintenance personnel with the skills required to service the new system. Equipment needs should also include handling units for removal of equipment. O&M manuals including a parts list and order form shall be provided for all equipment.

5. AUTOMATION - The servicing and operator training requirements for automatic equipment must be provided. Manual override is required for all automatic controls.

6. MONITORING, SAMPLING, AND LABORATORY REQUIREMENTS - Flow and pressure measurement devices shall be installed where necessary to satisfy operational and regulatory reporting requirements. Sampling points shall be available to permit the collection of samples to satisfy KDHE's reporting and procedural requirements for various water quality analyses.

   Reported analytical results must be performed by KDHE or KDHE certified laboratories. Analyses used to control plant operation can be made without certification but every effort should be made to conform to the procedures described in the latest edition of *Standard Methods for the Examination of Water and Wastewater* (13).

7. EMERGENCY PLAN - Potential disasters must be anticipated and plans formulated to abate their effect upon the provision of a safe and adequate water supply. Disasters which must be considered include: tornado, drought, flood, storms, fire, explosion, sabotage, vandalism, civil disorder, nuclear attack and fall-out, and power, equipment and operator failures. KDHE has prepared a guidance document to assist water utilities in the preparation and implementation of emergency plans (14).

8. SAFETY - Accident prevention and emergency service equipment shall be provided to minimize operational hazards. This will include proper ventilation, approved electrical fixtures, handrails, guards, grating, warning signs, and protective clothing and equipment. Applicable OSHA and NIOSH standards must be satisfied.

9. CONTAMINATION OF TREATED WATER - Cross connections and contamination of finished water by plants, animals, insects, or hazardous materials shall be prohibited.

10. DISINFECTION - All wells, pipes, tanks, and equipment which can convey or store potable water shall be disinfected in accordance with current AWWA Standards (4). P&S shall outline the procedure and include the disinfection dosage, contact time, and method of testing the results of the procedure.

11. HYDRAULICS - A hydraulic profile of the PWSS must be determined for the proposed designs. Also, consideration should be given to the required flow regimes for the system components.

    Hydraulic profiles should be drawn for average, maximum and peak hydraulic conditions in order to set adequate freeboard in basins and channels, and thereby allow establishment of critical elevations for process units and support facilities. It is important to satisfy the hydraulic needs of the processes as well as to acknowledge the topography of the site.

12. PIPING AND CHANNELS - All flow conveyance systems shall be designed to handle maximum expected flow with due consideration to solid deposition problems. Operational flexibility should be provided by appropriate use of interconnections and by-passes to and around the system components. Extra wall castings should be provided for future pipe passages through concrete structures. Chemical storage facilities should be kept close to unloading areas and points of chemical addition to reduce length of chemical feed lines.

    Table 2 presents a recommended color scheme for identifying various PWSS pipes. It is required for new facilities. It is further recommended that the name of the liquid or gas be painted on the pipe with arrows indicating the direction of flow. If a situation develops where two colors do not have sufficient contrast to easily differentiate between them, it is suggested that a 6 in (15 cm) band of a contrasting color be painted on one pipe at approximately 30 in (76 cm) intervals.

TABLE 2

COLOR CODE FOR PWSS PIPING

Water Lines	Raw	Olive Green
	Settled	Aqua
	Finishes or Potable	Dark Blue
Chemical Lines	Alum or Primary Coagulant	Orange
	Ammonia	White
	Carbon Dioxide	Dark Green with Red Band
	Carbon Slurry	Black
	Caustic	Yellow with Green Band
	Chlorine Gas	Yellow (under vacuum) Yellow with Red Band (under pressure)
	Chlorine Solution	Yellow with White Band
	Chlorine Dioxide	Yellow with Blue Band
	Fluoride	Light Blue with Red Band
	Lime Slurry	Light Green
	Ozone	Yellow with Orange Band
	Phosphate Compounds	Light Green with Red Band
	Polymers or Coagulant Aids	Orange with Green Band
	Potassium Permanganate	Violet
	Soda Ash	Light Green with White Band
	Sulfur Dioxide	Light Green with yellow Band
	Sulfuric Acid	Red with Yellow Band
Waste Lines	Backwash Waste	Light Brown
	Sludge	Dark Brown
	Sewer (Sanitary or other)	Dark Gray
Other	Compressed Air	Dark Green
	Gas	Red
	Other Lines	Light Gray

Source: *Recommended Standards for Water Works* "Ten State Standards" (4).